EVERGREEN-RICHMARK ANIMATION STAND
STUDENT RESEARCH PAPER

The Evergreen-Richmark Animation Stand

THE EVERGREEN-RICHMARK ANIMATION STAND

Built by:

Bill Stroud
John Cox
Wayne Thompson
R. Barnard

Introduction prepared by:

Chris Meyers
Christi Painter
R. Barnard

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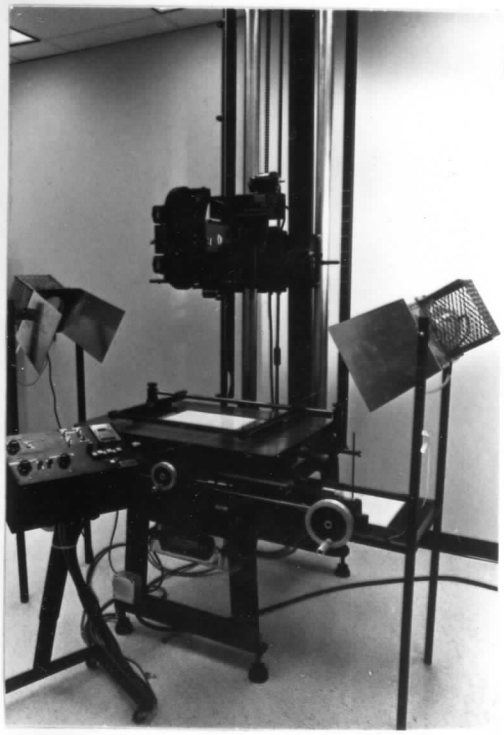


THE EVERGREEN-RICHMARK ANIMATION STAND

The Evergreen-Richmark Animation Stand is a hybrid. It is designed to provide a precise yet flexible relationship between a camera and the art work it is photographing. This is a twin column vertical stand with unusual flexibility, and potential for creating special effects as well as a capacity to photograph large art work. The camera is precise and designed to meet the exacting demands of the television and the motion picture industry. The major components of the animation stand are (1) The control panel (2) The camera (3) The column (4) The compound table (5) The lighting units.

The control panel.

The control panel regulates the movement of the film through the camera. It contains the motorized table and zoom speed controls, light circuitry and frame counter. The north-south and east-west compound table units have two controls. A speed control and direction switch. The camera zoom control is similar. The speed control should be set at an average speed setting of 8. Pressing the zoom lever up will move the camera in the up direction, down the opposite. The controls use precisely made switches and merely a touch of the finger will activate the appropriate motor.

The light control switches are conveniently mounted on the control panel and are clearly marked as to function. Located next to the light control switches is the buckle light. The buckle light signals red and stops the camera motor when any film jams in the camera. The camera interlock stays open until the unit is properly rethreaded.

The camera control switches activate the camera motor which drives the camera. The forward or reverse switches regulate the direction in which the film runs through the camera. The film is advanced in the camera in one of

two modes, single exposure or continuous. The action is accomplished by a solenoid in the camera drive mechanism which closes a clutch locking the continuous drive camera motor into the shutter mechanism. It is a positive mechanism which engages a steel pin at a precise moment. The single exposure button is used to expose one frame of film at a time while the continuous switch allows multiple frame exposures in the camera. The single frame exposure button has an interlock device. The operator must make one distinct push on the button for each frame to be exposed and the button must be released after each frame. Either the single frame or the continuous motion mode operates under the supervision of the pre-determining counter. This device must be set before any runs. The counter is set as follows: (1) Push the reset button (2) Press the red counter door release, set the number of frames desired for an effect by turning the thumb wheel to a higher number. Caution - only to a higher number. Forcing a number wheel will damage the counter. (3) Close the door, activate the camera by pressing either the single frame or continuous motion switch. The camera will stop at the pre-determined number. Super Caution - Reset the predetermining counter only when the camera is in the single frame mode.

The Animation Camera

This camera was designed and constructed specifically for animation and stop motion photography. (1) It has a single frame and continuous exposure control. (2) Forward and reverse movement of film. (3) A very precise intermittent movement and registration system which moves and holds each frame of film precisely the same position for each exposure. (4) A variable opening shutter with calibrated scale (5) A rackover viewfinder which permits viewing

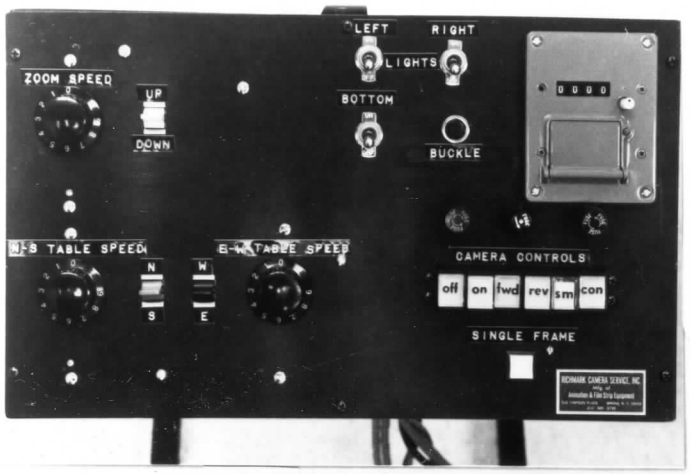


Fig. 1.

Fig. 1. The Control Panel.

Fig. 2. Speed Control and direction switches for table movements.

Fig. 3. Close-up of light switches, buckle light.

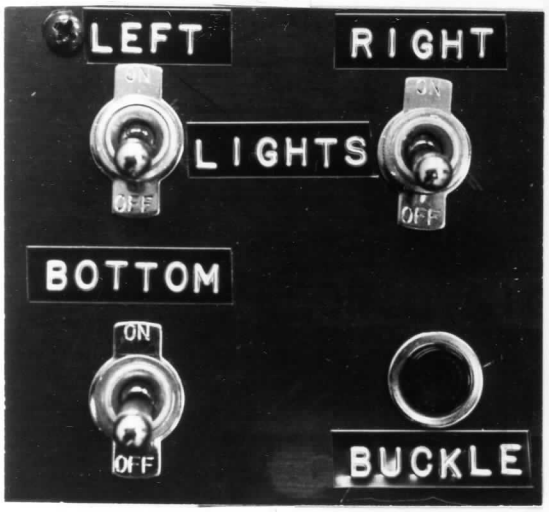
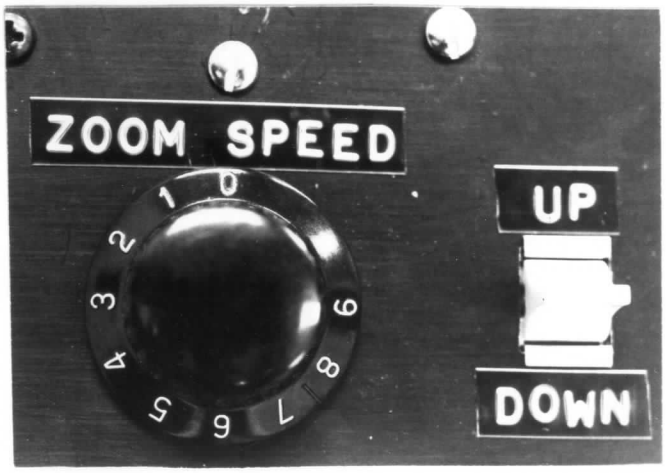


Fig. 3.

Fig. 2.



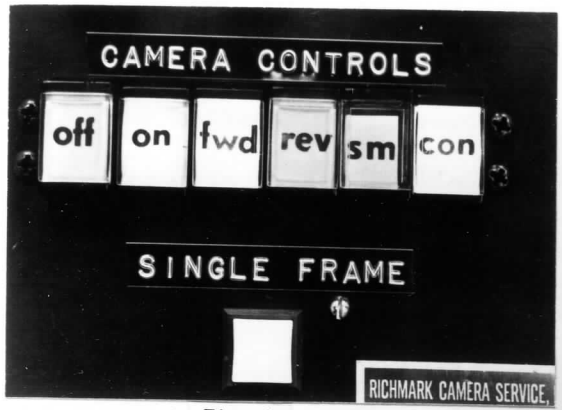


Fig. 4.

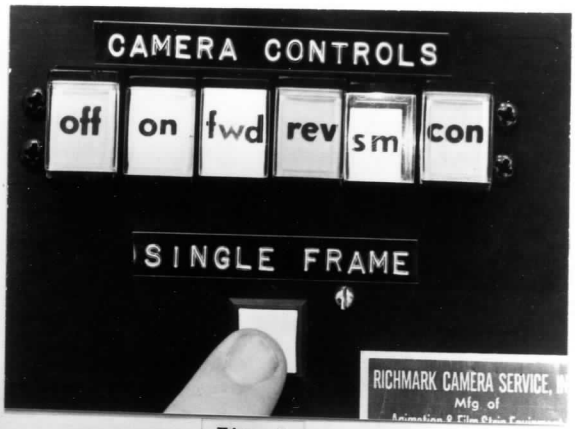


Fig. 5.

Fig. 6. (a)

Fig 6. (b)

Fig. 4.
Camera control switches (illuminated when activated) in continuous run mode.

Fig. 5. Camera control in single frame mode, only one frame can be exposed at a time until the single frame button is released.

Fig. 6.
Predetermining Counter.

Fig. 6. (c)

Fig. 6. (d)

Fig. 7.

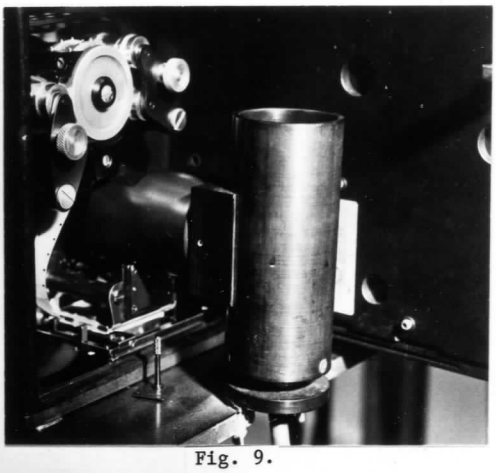


Fig. 9.

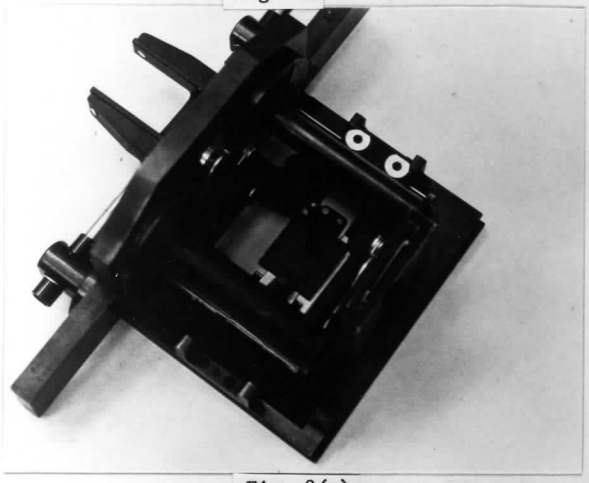


Fig. 8(a)

Fig. 10.

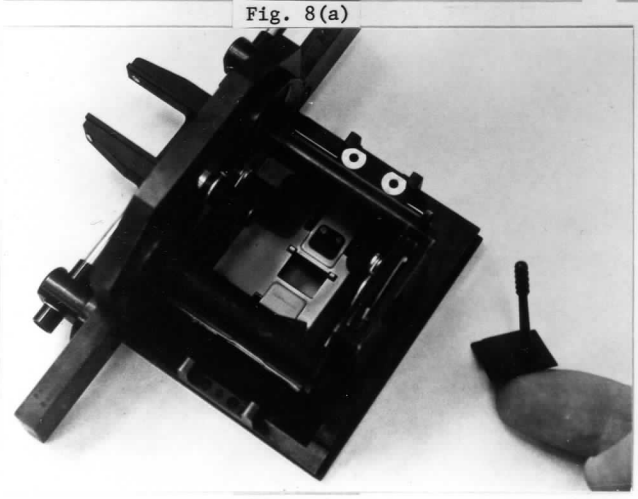


Fig. 8(b)

Fig. 7. Raising pressure plate to thread film, note the camera accepts double perf film only.

Fig. 8. (a.) Aperture plate in place
(b.) Aperture plate removed for rotoscoping.

Fig. 9. Projection light set up for rotoscoping.

Fig. 10. Shutter release switch normal position is up, must be held down momentarily to release shutter when rotoscoping or threading.

which are controlled from the back of the control panel. In practice, 200 frames of film is run through the camera onto the take-up reel. The work is filmed and an additional 200 frames is run onto the take-up reel. The film is cut as it enters the take-up compartment of the magazine and a new supply of film is threaded onto a new take-up spool.

The Shutter, Fades and Dissolves

The variable opening shutter is a key feature of the animation stand and is the primary means of creating precise fades and dissolves. The shutter is a disc with a sector removed to yield an aperature of 170^{o}. It rotates once for each frame of film exposed. The camera stops when the solid shutter is obstructing the light path. When the shutter opening is closed down in progressive phases, the amount of light reaching the emulsion is reduced. A fade-in, for example, is accomplished by starting the camera running when the shutter opening is set at 0^{o} and progressively increasing the shutter opening for each successive frame of film until the sector opening reaches its maximum. The increment intervals have been worked out on a scale to provide a visually smooth transition. This is called a fade scale. A dissolve is described as a fade-in fused with a fade-out. And this is how it is executed with the animation camera. The same length of film is exposed twice, once with a fade-out of the outgoing scene and once with a fade-in of the incoming scene. For example, if a 24 frame dissolve is used as a transition from one scene to another, the shutter closes one increment on the dissolve scale for each of 24 exposures on the outgoing scene until the fade-out is complete. The camera drive switch is put in reverse and the film is backed up in the camera for 24 frames with the shutter closed until the point is reached when the fade-out begins. This is accomplished accurately by setting the predetermining

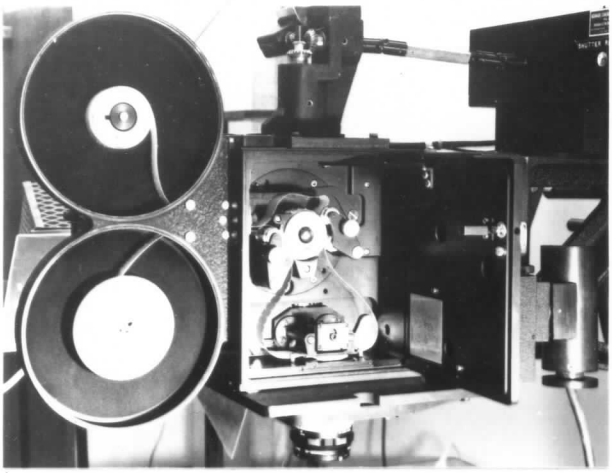


Fig. 11.

Fig. 11. The camera correctly threaded and magazines loaded correctly.

Fig. 12. Magazine in unloaded configuration.

Fig. 13. Caution: Do not lose hold of magazine covers: dented or warped covers are useless.

Fig. 14. The camera with shutter control.

Fig. 15. A close-up of the variable shutter control. The outside scale is for dissolves, the inner scale for fades. Generally one frame is exposed for each graduation. Extra frames per graduation or skipping graduation will give uniform longer or shorter effects.

Fig. 12.

Fig. 13.

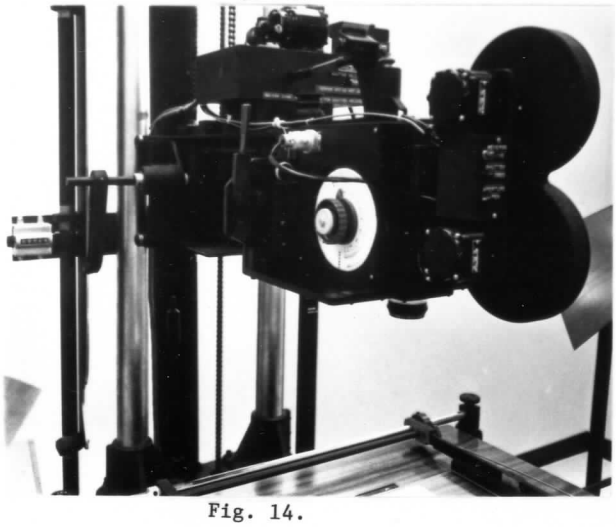


Fig. 14.

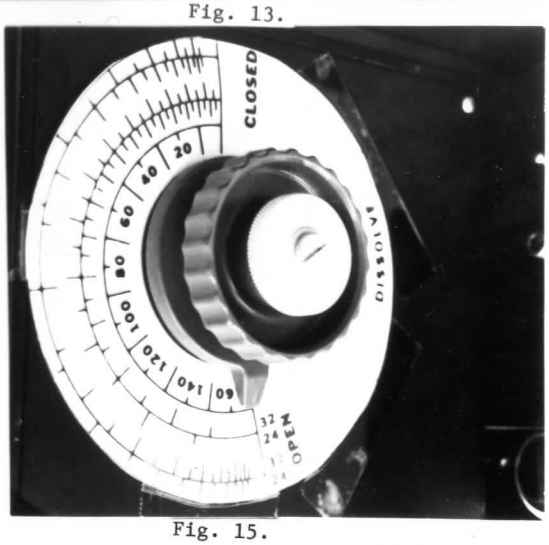


Fig. 15.

counter for 24 frames. Then the incoming scene is placed under the camera and is photographed with a 24 frame fade-in. The dissolve is complete. Generally, fades are executed in the single frame mode with the operator pushing the single frame button with one hand and turning the fade control with the other. Caution: Avoid arms between the lights and camera which might cast shadows on the art work.

In many aspects of animation photography, it is important to see the artwork through the camera lens in order to compose the scene properly and check on the accuracy of complex moves. A monocular eyepiece can be placed into the camera mechanism. To use this viewfinder, the main body of the camera is moved to one side on a precision track or rackover. The viewfinder is then brought into alignment with the film aperature and fixed into position by registration pins. By looking at the ground glass viewfinder, you can see the artwork exactly as it will appear on the screen. After the scene is composed and the lens focused, the viewfinder is racked over to the side and the camera body is returned to its former position for actual photography. The lens used on this animation camera is a 28mm lens. It is an adapted 35mm Nikkor lens to keep the system as free as possible from lens defects such as distortion, and spherical aberrations. The lens is focused automatically at any height by means of a follow-focus mechanism which is a part of the column. There are three warning circuits to alert the operator to possible problems. The warning lights are located on the face of the camera. The top light signals amber when the camera mechanism is in reverse. The potential error is to back the camera up for a dissolve, overlook the direction change, locate new artwork under the stand, and start a camera movement which would spoil the preceding scene. The center red light alerts the operator that the camera shutter is closed. This is to avoid starting a scene, following a fade-out

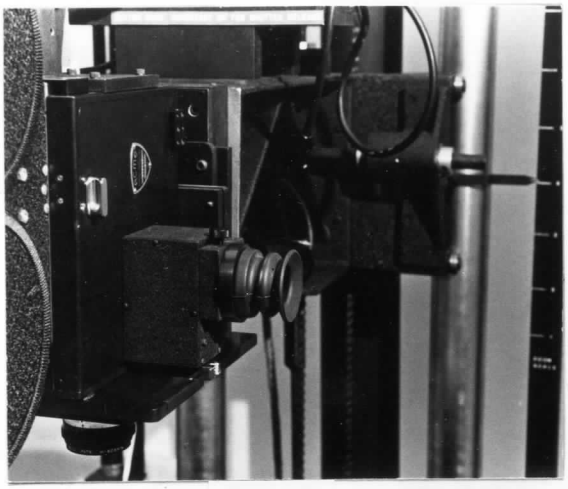


Fig. 17.

Fig. 17. Removable eye piece for critical focusing or registration of copy.

Fig. 18. The 28mm. f/1:35 camera lens. Note: IT IS ESSENTIAL that the focus ring always remain set at infinity.

Fig. 19. Interlock warming lights.

Fig. 18.

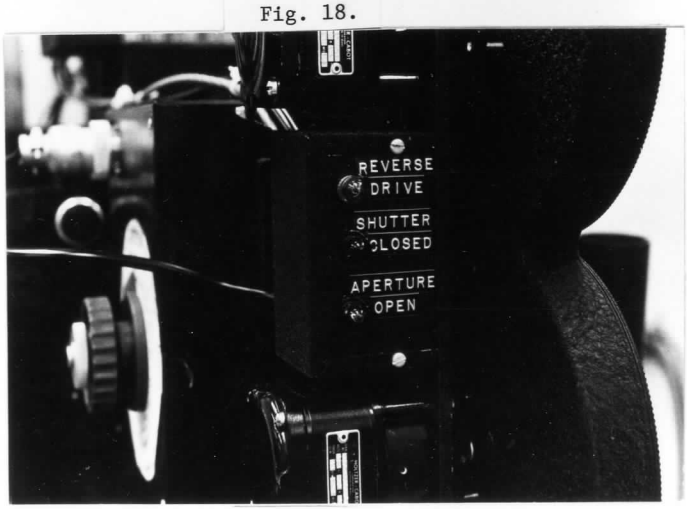


Fig. 19.

without making the proper shutter adjustments. The lower red light alerts the operator that the camera aperture is wide open. The camera in normal operation operates between f-8 and f-16. However, in the rackover mode, it is necessary to open the lens wide open for good viewing through the eyepiece, or to use the projection reticule. Many scenes are needlessly overexposed by an operator who forgets to shut down the aperture after making a projection check.

Located at the top of the camera mechanism is a cumulative frame counter. This is set at the time a new roll of film is placed into the camera magazine and is the only record the operator has of the amount of film left to be exposed. In practice, a small piece of masking tape with the starting cumulative count is put on the control panel over the predetermining counter. A corresponding piece of masking tape is placed below the cumulative counter, giving the total number of frames at start in the magazine, e.g., 16,000 frames for a 400 foot load.

The Carriage

The camera unit is mounted on a mobile carriage which rides up on two vertical steel columns. The carriage is moved on the column by a variable speed motor controlled from the console. Field size varies with the distance of the camera from the surface of the animation table. The closer the camera approaches the compound table, the smaller the field. The range of 1 to 12 on the field guide is a practical working size for this stand. Sizes smaller or larger than these fields may require a special lens. The camera carriage has an electrical limit switch which stops the camera if it goes closer to the table than one field or larger than 20 field. The red button on the

Fig. 20. Accumlative frame counter, set at 0000.

Fig. 21. Accumlative frame counter, reading 0154 frames run through the camera.

Fig. 22. Field area projected onto platen.

Fig. 23. The complete camera carriage.

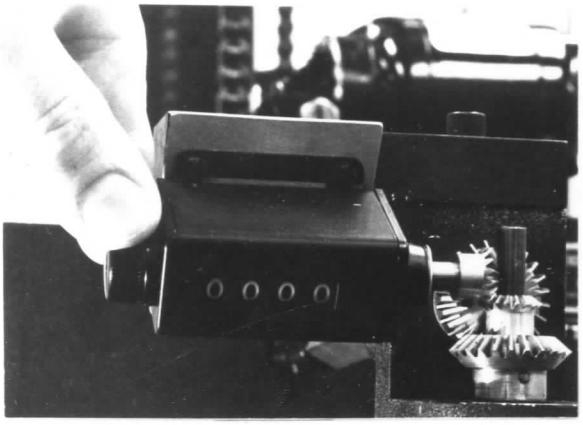


Fig. 20.

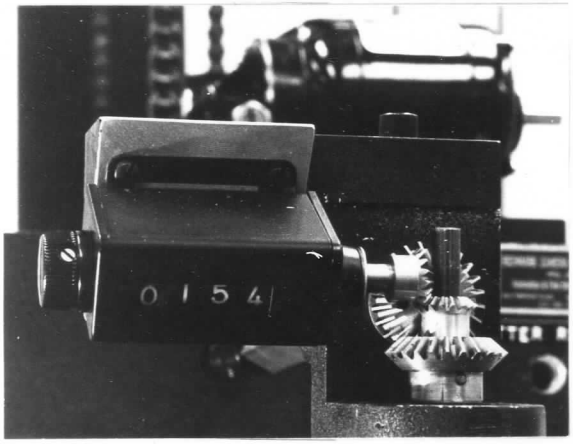


Fig. 21.

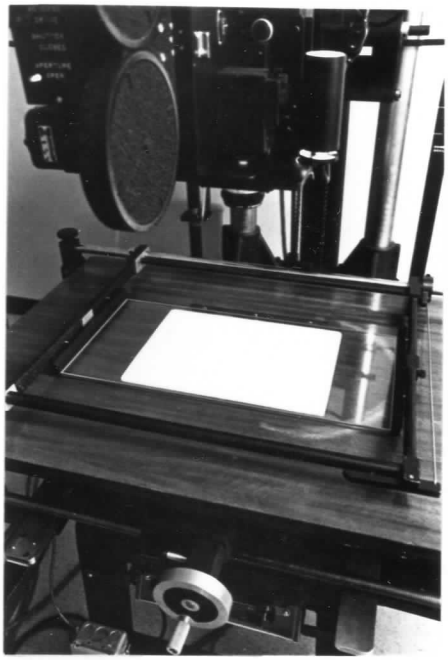


Fig. 22

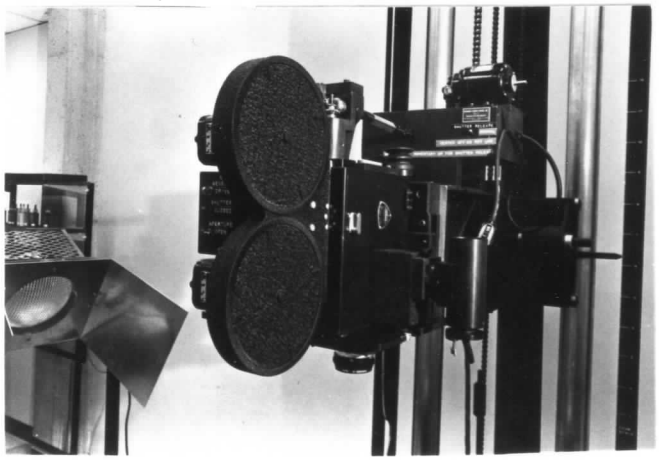


Fig. 23

back of the control console over-rides the limit switch. Note on the left of the camera carriage that there is a mechanical zoom counter which measures movements up and down the column in hundredths of an inch. These are arbitrary numbers and should be noted for exact reference. A scale of field position levels is located on the right of the animation stand.

The Animation Compound

The animation compound carries the subject being photographed. The major components of the animation compound are (1) the photography table top and its registration pegs, (2) the platen, (3) the controls for north, south, east, west movements of the compound, (4) the pantograph unit, (5) the rotary unit, (6) and the floating peg bar.

The photography area of the compound is in the center of the table, aligned directly under the central axis of the camera lens. On the north side of this area are three registration pegs which correspond to holes punched in the field guide and artwork. These pegs correspond to the "Acme" punch system. Any artwork punched with the proper holes and planned with the proper field guides will fit over these registration pegs. The importance of the field guide-registration peg relationship cannot be overemphasized. It is the master reference system of animation and the basis for all planning. It sets this device aside from homemade units. A subject being photographed may at any time be placed on the stand and aligned to the established standards and recorded accurately on film.

Most forms of animation artwork need to be pressed together in order to eliminate shadows from the sidelights. A platen system for the stand

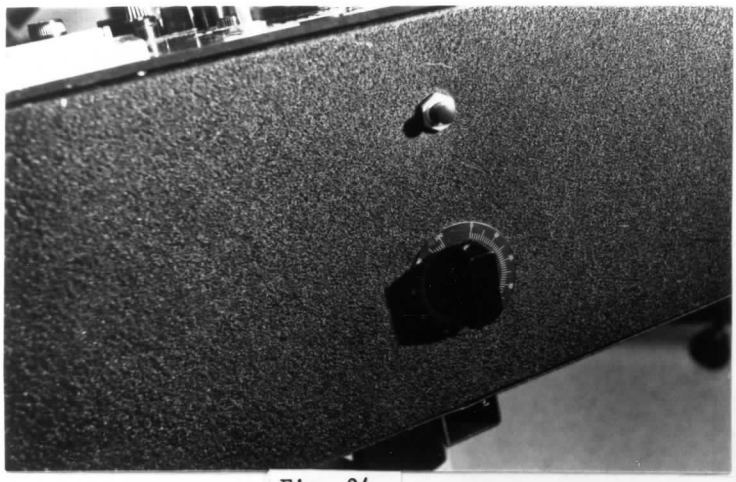


Fig. 24.

Fig. 24.
The top button is a limit override. If the camera carriage is moved to an extreme position, it will stop. The override control and zoom switch must be pressed simultaneously to re-set.

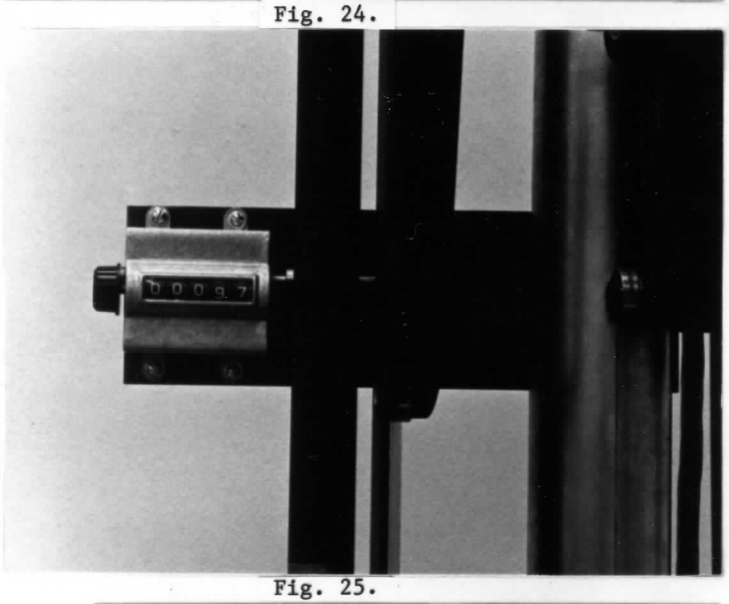


Fig. 25.

Fig. 25.
Zoom counter - reads 00097. These arbitrary numbers.

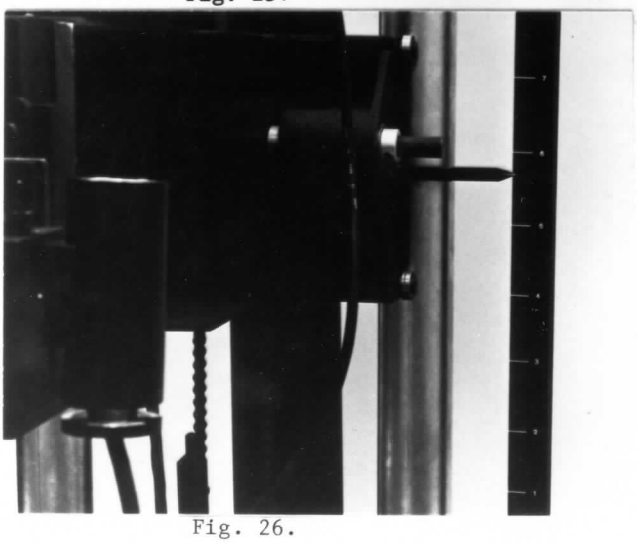


Fig. 26.

Fig. 26.
Zoom field guide. Field guide indicates approximately 5-3/4.

consists of a waterwhite glass in a manual frame. A detent will enable it to stay up in either of two stationary position. Extreme care must be taken to keep this platen clean and free from scratches. Always clean in an east-west direction using the Windex supplied.

Pans are executed by moving the compound tablework bearing the artwork between each exposure of film. The compound is attached to two lead screws, one controlling north-south movements and another controlling east-west movements. Each of these cranks is manipulated by either a hand crank or a motor controlled from the control panel. Each of the lead screws is interlocked with a cumulative counter system calibrated to measure the compound's movement at one-hundred increments to an inch. In dead center, each of the counter's registers 00000. Remember that the standard aspect ratio for animation is 36 to 50 and that all field size subdivisions also exhibit this 36 to 50 proportion. To distinguish between north and south of 00 on the north-south counters, each field north of 00 cumulative adds 36 increments to 00000 and each field south of 00 cumulatively subtracts 36 increments from 00000. One step east of 00000 would add 50 increments to 00000 and read as 00050 on the east-west counter. A pan west from 00 to 1W would subtract 50 increments from 00000 and read as 99950.

The floating peg bar enables you to mount a background on one side and move it independently of cels attached to the table pegs. A word of caution: The floating peg bar is not tied to any standard and thus it must be set up each time with the standard field guides.

To the right of the animation compound is a flat wood surface with a field guide mounted on it and a steel pointer suspended over it. This unit

Fig. 27. Remember, always wear gloves in handling the glass platen. It should be cleaned with windex. Always clean glass left to right to avoid scratches at angles to the light source.

Fig. 28. The floating peg bar indicator counter.

Fig. 29. Table position indicator counter.

Fig. 27.

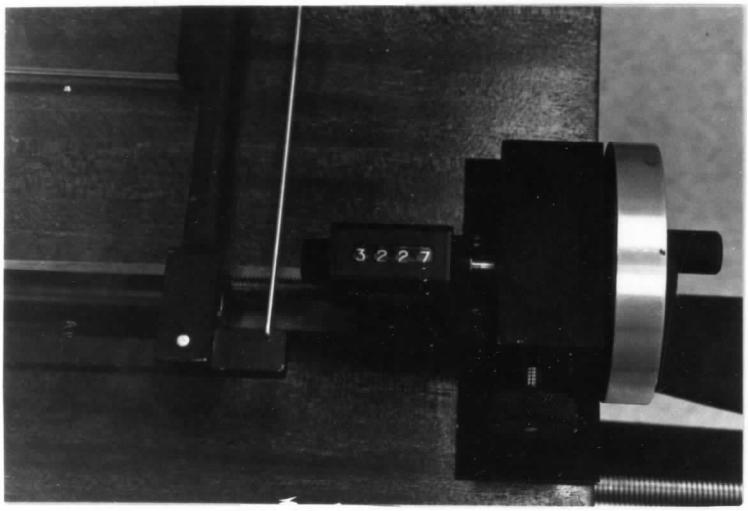


Fig. 28.

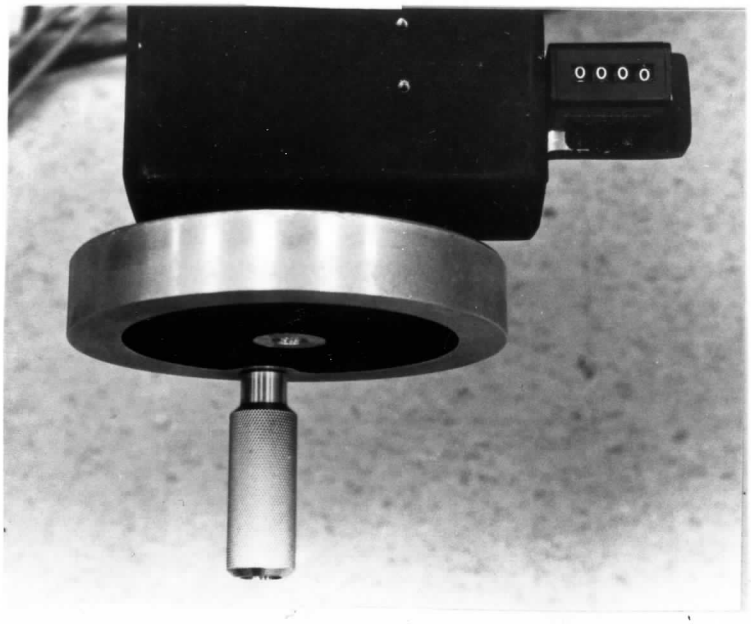


Fig. 29.

is called the pantograph. The pantograph field guide corresponds exactly to the photography area on the component tabletop. When the compound moves in execution of a pan, the pantograph needle also moves and indicates the new center of the field being photographed. The primary function of the pantograph is to facilitate the execution of curved and free-form pans.

Pan and Zoom Speeds

Pans and zooms on the animation stand are computed as a set of equally divided steps between each exposure of the move. But if the camera or table moves in equally divided steps, the effect will appear to start abruptly, move woodenly, and end with a jerk. To cushion the shock of beginning and ending a zoom or pan, it is important to ease in and ease out of the move. Starting with very small incremental steps, increase the length with each step and a satisfactory ease-in can be made. Zoom charts with calculated increments are available in the animation room. You are referred to Roy Madsen's Animated Film page 63-71 on Calculating Pan Speeds and using the pantograph to plan complex moves.

Lighting

The stand is lighted by two large light sources, one on each side of the compound. 1000-watt, FAT, quartz coarse iodine lamps, calibrated at a color temperature of 3200° C. are used. Provision is made in this animation stand for back lighting titles or cels. The compound has a removable 9 x 12 inch inset in the photography area which can be replaced by a panel of translucent glass. Beneath the glass there is a 650-watt light.

The lighting levels should be checked before each run at the center and each side of the field being photographed.

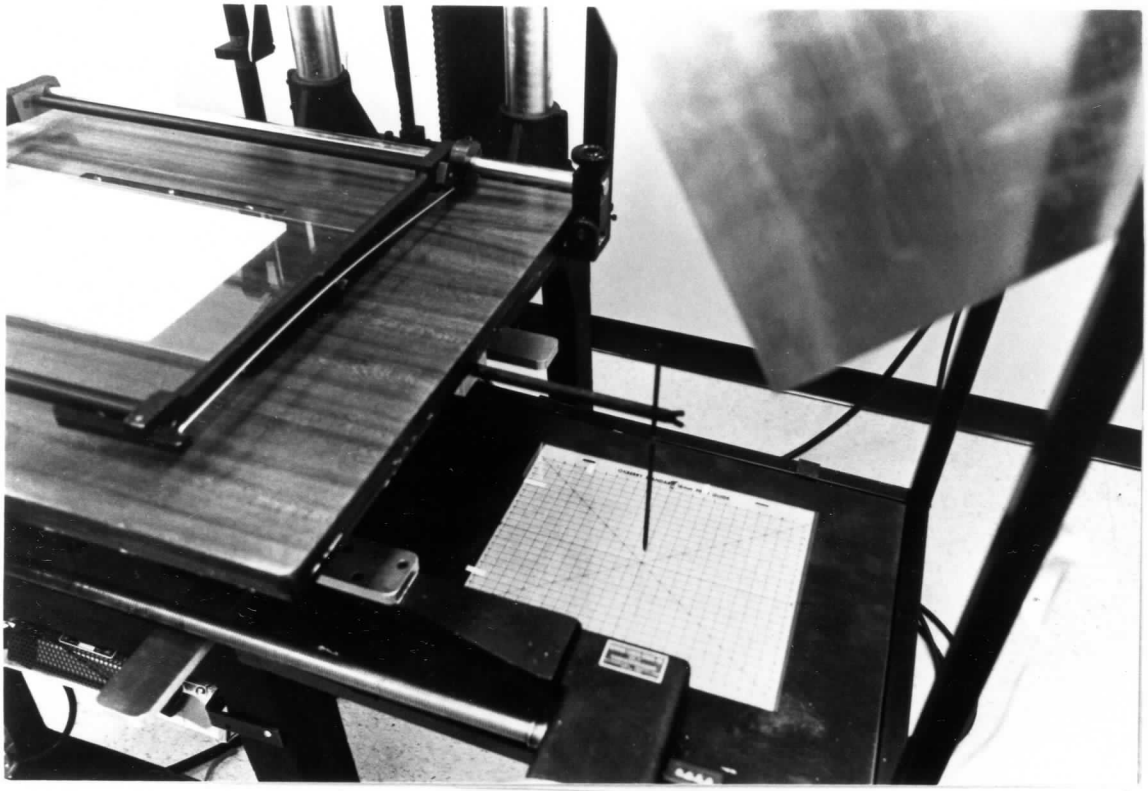


Fig. 30.

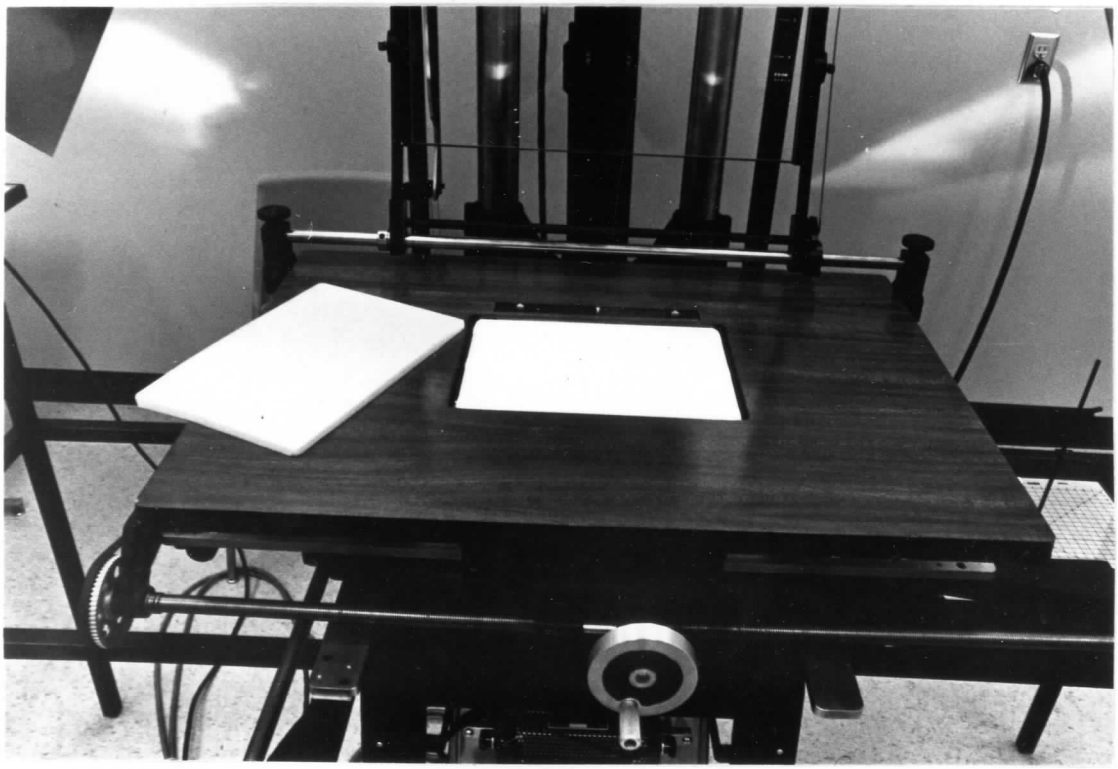


Fig. 31.

Fig. 30. The Pantagraph.

Fig. 31. Sponge rubber base removed and milk-white back lighting glass exposed.

Table 1(a)

```
GET-MØVE
LIST
MØVE

900   PRINT "PEAKINESS";
910   INPUT K
920   PRINT "NUMBER ØF FRAMES";
930   INPUT F
940   PRINT "N-S BEGIN,END";
950   INPUT A1,A2
960   PRINT "E-W BEGIN, END";
970   INPUT B1,B2
980   PRINT "ZØØM BEGIN, END";
990   INPUT C1,C2
1100   D1=4/F
1200   N=0
1300   FØR I=1 TØ F
1400   T=I*D1-2
1500   Y=EXP(-K*T*T)
1600   N=N+Y
1700   NEXT I
1710   PRINT "FRAME  N-S  E-W  ZØØM"
1800   A=(A2-A1)/N
1810   B=(B2-B1)/N
1820   C=(C2-C1)/N
1900   N=0
2000   FØR I=1 TØ F
2100   T=I*D1-2
2200   Y=EXP(-K*T*T)
2300   N=N+Y
2310   A0=A*N+A1
2320   B0=B*N+B1
2330   C0=C*N+C1
2400   PRINT  USING 2410;I,A0+(A0<0)*10000,B0+(B0<0)*10000,C0+(C0<0)*10000
2410   IMAGE 4D,7D,6D,6D
2500   NEXT I
2600   GØTØ 900
2700   END
```

TO USE THE COMPUTER PAN AND ZOOM PROGRAM

1. Type in your computer number.

2. Type "GET-MOVE".

3. Type "RUN".
   The teletypewriter will print:

   PEAKNESS?
   NUMBER OF FRAMES?
   N-S BEGIN, END?

   E-W BEGIN, END?
   ZOOM BEGIN, END?
   FRAME N-S E-W ZOOM

The operator should answer appropriately: See Table 1(b).

The complete computer program is shown in Table 1(a), and a run in Table 1(b).

Table 1(b)

```
PEAKINESS?.5
NUMBER ØF FRAMES?48
N-S BEGIN,END?15,980
E-W BEGIN, END?54,70
ZØØM BEGIN, END?950,970
```

FRAME	N-S	E-W	ZØØM
1	20	54	950
2	27	54	950
3	34	54	950
4	42	54	951
5	52	55	951
6	63	55	951
7	75	55	951
8	89	55	952
9	104	55	952
10	121	56	952
11	140	56	953
12	160	56	953
13	182	57	953
14	206	57	954
15	232	58	954
16	259	58	955
17	287	59	956
18	317	59	956
19	347	60	957
20	379	60	958
21	412	61	958
22	445	61	959
23	478	62	960
24	512	62	960
25	546	63	961
26	579	63	962
27	611	64	962
28	643	64	963
29	674	65	964
30	704	65	964
31	732	66	965
32	759	66	965
33	784	67	966
34	808	67	966
35	830	68	967
36	850	68	967
37	869	68	968
38	886	68	968
39	902	69	968
40	915	69	969
41	928	69	969
42	939	69	969
43	948	69	969
44	957	70	970
45	964	70	970
46	970	70	970
47	975	70	970
48	980	70	970

The adjustment of lighting is critical. Be sure to take into account the room lighting during the setting up of an artwork scene on the animation stand. Be sure the room lights are turned off and the total contribution comes from either the back light or two side lights. During operation of the stand, it is also important to keep the room lights off to minimize any possibility that the operator's shadow could be cast onto the tabletop.

The Field Guide

The field guide is unique to animation. It is the stage upon which all the moves in animation are planned. A field guide is a chart on clear acetate representing the entire area which may be photographed on the animation stand. Three holes are punched at the top of the field guide to correspond to pegs on the animation stand. The three punches represent the standards by which an animator can plan his work with the confidence that there will be no discrepancy in registration between the plotted moves, location of artwork, and their execution on the animation stand. The field guide is a rectangle whose width and length are on a standard aspect ratio for animation, 36 x 50. There are 12 field sizes on the field guide ranging from the 12 field which is the total area of the guide down to the 1 field in the center.

The Exposure Sheet

The exposure sheet is the road map of animation. The exposure sheet makes provision for virtually every aspect of animation photography. The main body of the exposure sheet is divided horizontally and vertically. Each horizontal line represents one frame of film. There are 60 frames represented on one sheet. Note the headings across the top of the exposure sheet. The action

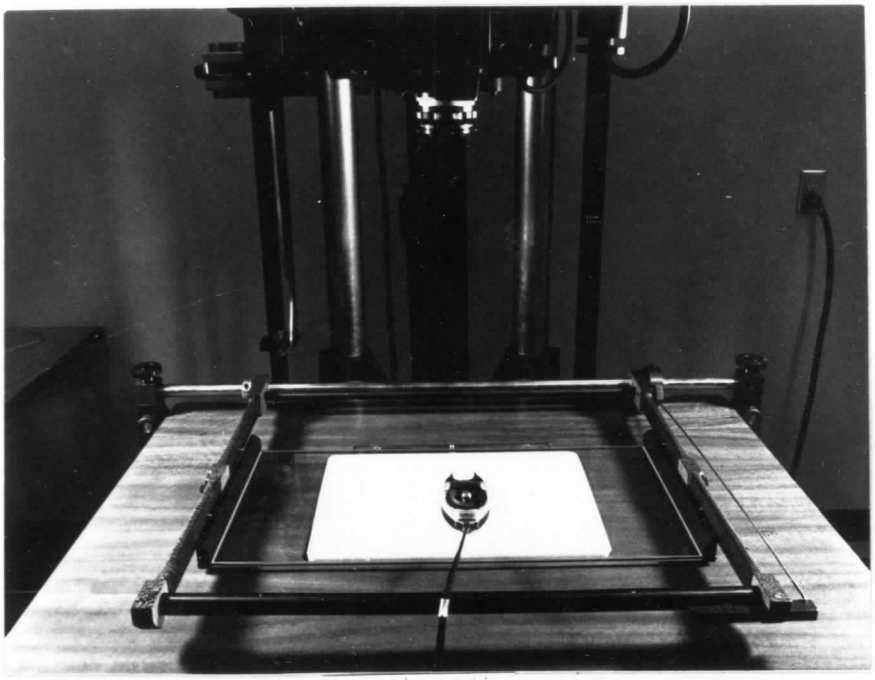


Fig. 32.

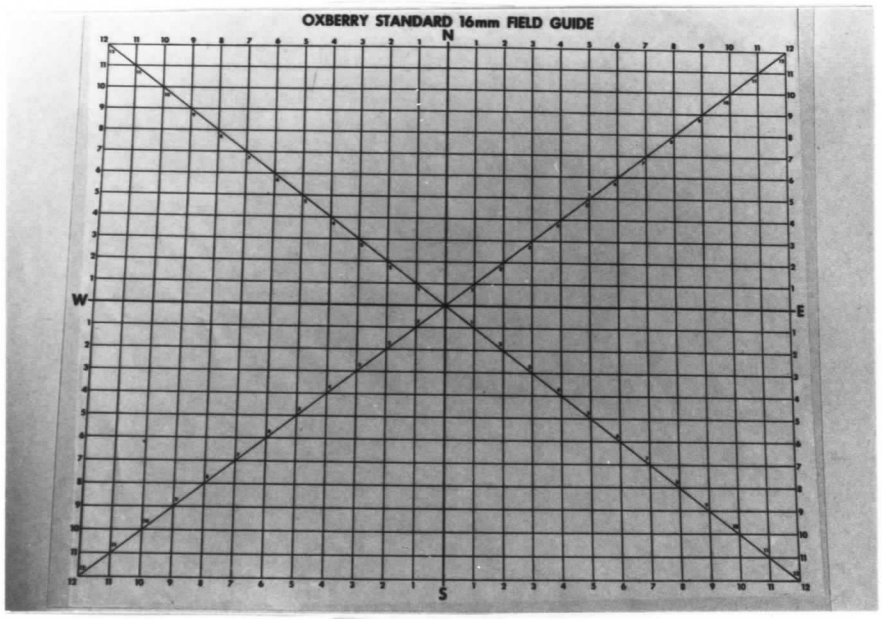


Fig. 33.

Fig. 32. Exposure check. Should be made at senter and both sides of field. Light level should be uniform.

Fig. 33. The Oxberry field guide.

column requires a brief description of the action. The exposure sheet is set up for 4 cels and a background. Effects are marked on each sheet as standard editing effects. The zoom counts and table movements are taken from the counters. The "Fr" or numbering column is essential. Numbering on the exposure sheets is cumulative and begins with frame number 1 of the film. In addition, zooms, pans, and compound moves must also have their special beginning and end numbers entered in the appropriate frames. Be sure to keep the exposure sheets numbered in sequence with lots of camera instructions. Remember, many times you will be correcting only one scene out of many and the exposure sheet is your only working guide. You can not trust your memory in film animation.

Inking and Painting Techniques with Cartoon Colours

Specifications

Regular Cartoon Colours (blue label) are made in a rewetable base for animation and all types of art work where an opaque color is desired. It can be washed off of surfaces such as glass or celulose acetate. Regular Cartoon Colours are excellent for air brush use. They are light-fast and brilliant. Regular Cartoon Colours are supplied in base colors only with no cel compensations. Regular colors are packaged in squat glass jars only, as the consistency of the paint is too thick to conveniently pour from squeeze bottles. Regular Cartoon Colours are hygroscopic and may be affected by wet or dry weather. In humid climates or during humid weather the REGULAR colours may become tacky or during dry weather periods the REGULAR colors may dry out and become brittle. Both REGULAR and CEL-VINYL colors can be thinned with water. Although REGULAR and CEL-VINYL colors cannot be mixed into one another, each type can be intermixed with the colors within its range.

CEL-VINYL COLOURS (yellow label) were developed to afford to the artist all of the conveniences resulting from modern paint chemistry. As a result, they fill the need for an opaque, waterproof, high quality artist's paint that can be applied in the same manner as previous rewetable colors. CEL-VINYL COLOURS are made with a polyvinyl-acrylic base which forms a pigment carrying emulsion in water. Upon evaporation of the water, there is left a durable film of color which adheres to practically any surface. The color can be removed with a plastic stylus. Cel-Vinyl Remover, recommended for air brush, can be used provided the instrument is thoroughly cleaned with water and Cel-Vinyl Remover after use. The needle in the air brush should then be pulled back during periods of idleness. Sable brushes can also be cleaned by allowing to soak a few minutes in Cel-Vinyl Remover. Cel-Vinyl Colours are light-fast and brilliant. They are supplied in base colors and cel level compensations in a wide range of over 900 tints, tones and grays. Strip, swatch charts of these compensations can be supplied on request. Cel-Vinyl Colours are supplied in both squat glass jars and pliable plastic squeeze bottles with pointed spout caps. Cel-Vinyl is not hygroscopic and therefore not affected by wet or dry weather.

Procedures

The following steps represent normal procedure in application of acetate paint:

1. The original animation should first be done on a white 16 or 18 lb. bond paper. Colors of the finished animated characters should then be indicated directly on selective animation drawings in blue pencil or a separate color model should be prepared.

(*CARTOON COLOUR is the registered trademark of Cartoon Colour Co. Inc.)

2. An acetate cel (Acetate Cellulose Sheeting .005" gauge) is placed on top of the artwork, being careful that both the art work and cel are in exact relation (registration) at all times. Normally, this is accomplished by use of registration pegs. (Animation industry standard Acme Peg Bars or similar device).

3. A hand tracing is then made from the original drawing onto the cel with specially formulated acetate ink, Cel-Vinyl Ink, Stabilo, or Staedtler all surface marking pencils. A Xerox process is also available for electrostatically transferring animation images from paper to cels.

4. Once the outline is complete, the paper with the drawing is removed and used only as a color guide. The cel is then turned over and the Cartoon Colours are "puddled" on the reverse side of the cel allowing the inked lines to read against the colored areas. Regular Cartoon Colours and Cel-Vinyl Colours should be thinned somewhat for painting by mixing in water in a small working jar with a thin stick or brush handle. Care must be taken not to thin them to the point where they will become transparent. The optimum consistency is when the paint levels well and yet will cover without showing thin areas. The brush is heavily loaded so the paint will "flow" off. The paint is not stroked but "puddled" (paint applied thickly and brush is moved in small circular motions) into the areas to be covered. This prevents streaking. The painted areas must be opaque to obtain the proper brilliance on the reverse side. If colors are applied too thick on the cel, however, they may build up a layer which will cast shadows around the animated character when placed under the camera platen. When applying the color, care must be taken to cover the complete area

with a slight overlap of the inked lines to prevent paintless areas within the positive spaces of the characters. The brushes used for inking and mentioned below provide best results for painting as well.

5. Mistakes in inking and painting can be corrected with the proper techniques. While ink or paint remains wet, a "Q-Tip" may be used to remove smudges or straying lines or color. Soft paper towels may be used to correct incorrect colors or large areas. After ink or paint is dry, water can be used to remove Regular Colours or Cel-Vinyl Remover solution and a plastic stylus/orange stick, carefully used will remove Cel-Vinyl Colours without scratching the cel.

Materials and Equipment

When using Cartoon Colours or inks supplied by Cartoon Colour Company there is no special preparation of the cel surface for inking or painting. The new cels are absolutely clean when purchased. Some may have to be discarded because of defects. If the cels should become oily or dusty, a light cleaning with a damp cloth is sufficient. If they are badly fingerprinted it may be necessary to use a cleaning solvent such as Dual Clean or Freeon. Dust may be removed with Dual Clean Anti-static cloths. The cels available through Cartoon Colour Company have a higher dimensional stability than normal cels and as a result lay flatter and are considerably easier to work with. They are more economical than regular cels and highly recommended for Exrox processing, friskets, and use with our colors. It is good practice to wear cotton gloves when handling cels to prevent finger and handprint marks. Inkers and painters usually cut off a glove thumb and two adjacent fingers of the inking or painting hand to allow more freedom of motion with pen or brush.

Pen points for inking on acetate cels should have a flexible point so that thick and thin lines may be applied and feathered at the start and end of the stroke. For regular width lines, use Esterbrook 357, 228, and 358 or Gillott 290, 1290, and 303 points with varying pressure. For fine lines and detail work, Crow-quill points of the Esterbrook 62 and Gillott 659 type can be used effectively. Sable brushes may also be used for inking. Popular brands are Art-Sign-Finepoint Series-9, and Winsor-Newton Series-7 in #1, #2, #3, #4 sizes. A ruling pen is sometimes used in inking, but this is only useful when making straight lines along a straight edge. Occaisonally used is the Koh-I-Noor Rapidograph and Acetograph drawing pens, sizes 000, 0, 1, 2 or 2 1/2. These pens have an orifice with a small wire plunger for starting them and even-width lines can be produced. Interesting free-hand techniques are possible with these pens and the less skilled inker may find them very practical. The lines made with the Rapidograph pens, however, are very difficult to feather. Acids used in certain acetate inks are very strong and may damage brushes and pens such as the Rapidograph (the Acetograph pens are designed to withstand these acids); therefore, their life can be prolonged by frequent cleaning. Certain effects can be produced on cels without use of pen or ink for tracing the animated images. Some artists prefer to use All-Stabilo or Staedtler-MARS-Omnichrome pencils which mark on plastics and films. The pencils are available in the primary colors, brown, black and white. They are sharpened in a regular pencil sharpener. This pencil technique probably requires the least skill and results are achieved most rapidly. A similar technique employs matte acetate sheets

which are textured on one surface and can be drawn upon with regular colored or graded drawing pencils. The reverse sides of these cels can then be painted in the normal manner.

Newest of the processes used in animation to transfer drawings to cels is the Xerography system. An electrically charged plate (similar to a photographic plate) is exposed to the animation drawing in a camera much like a line copy camera. The plate is then placed in contact with a cel and the image charge held by the photoconductive plate is transferred to the cel. The cel then goes through a development state in a dry toner which is later bonded or "fused" by vapor making the image permanent on the cel surface. This system can be of great economic value in cases where the animated characters in scenes are numerous or there is a great amount of detail on each drawing. Likewise, where studios are involved in large scale TV production of cartoon series, the Xerox unit, properly staffed, can efficiently and rapidly process large quantities of cels. (Cartoon Colour Cels are highly recommended for Xerox.) Xerox can also be of value to units who do not have sufficient numbers of trained personnel to meet inking needs.

Several popular inks are used for inking cels. Artone Opaque-Removable, Koh-I-Noor Acetate, Pelican-T, and Cartoon Colour Cel-Vinyl Ink in BLACK are recommended. Some artists prefer to mix these brands together to arrive at a consistency suitable to their individual taste. Colored Inks are rarely used in animation although they are available. Most inkers use a "water mix" solution of diluted Cel-Vinyl Colours which they mix to proper consistency through trial in a small working jar.

Special Effects

In addition to regular inking and painting techniques, special effects can be produced by using additional materials and methods. Cartoon Colour

Company has both a TRANSPARENT WHITE and TRANSPARENT BLACK paint available. The TRANSPARENT WHITE can be used for smoke effects, glass effects, ghost effects, fins on fish, dust effects, various space effects, shadows, and bubble effects. By adding water color or food coloring to the TRANSPARENT WHITE, color tones in the same effects can be achieved. Additionally, colored china markers can be used over TRANSPARENT WHITE to give a textured effect for fire and glow effects when the transparent color has been surface painted ("surfaced") on the ink side of the cel. The TRANSPARENT BLACK is available for use as smoke effects. By using these transparent colours, the necessity of double exposing (D Xing) certain levels of cels in the camera can be eliminated thus saving camera time and economizing. Special effects can also be produced by"surfacing " Cel-Vinyl and Regular Cartoon Colours to achieve a matte effect for water etc; these "surfaced" colors can also be "toned" with pastel sticks and powder to render shadow and give modeling effects. Dry brush effects on the surface of cels can also be used to produce cyclonic effects, speed effects, and water effects.

Cel Compensations

Color compensations can be made in the artist's studio by painting a 1" x 2" swatch of the desired color on a cel. Lighten some of the desired color with Cartoon Colour White and paint a small swatch next to the original swatch. Place the required number of cels over the small swatch and if your mixture is correct the large and small swatch will match. If continued testing is necessary, you have room available for additional small swatches alongside the original swatch. The total number of cels photo-

graphed at one time is generally held to not more than four, or at the most, five. Cartoon Colour Company supplies accurate compensations in a wide range of all of their forty-two base colors and also 40 grays in the Cel-Vinyl Line.